The Fatal Paradox of Classical Physics in Black Holes

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Abstract

Classical physics accurately describes the exterior of a black hole but conceals a conceptual void between the event horizon and the singularity. In that region, the notion of an extended body ceases to be valid: each part of the object collapses individually, destroying the system's continuity before reaching the center. This work formulates the paradox with relativistic rigor—the "singularity of the parts"—and demonstrates that the formalism of general relativity cannot describe the transition between both regions without losing the physical definition of matter. The ontological character of this discontinuity is discussed, and it is shown that its resolution requires the existence of an underlying continuous medium.

1 The Invisible Paradox of the Black Hole

1.1 Intuition Facing the Impossible

A black hole is defined as a body so dense that not even light can escape. The idea seems simple but contains a profound problem. If nothing can leave, how does the body itself continue to exist inside? What happens to its matter when neither space nor time behave as before?

Classical physics successfully describes how a star collapses under its own weight, but when the same laws are applied beyond a certain limit, everything becomes contradictory.

1.2 The Point of No Return

As the star contracts, its escape velocity increases. At a certain moment, it reaches the speed of light: this is the **Schwarzschild radius**, the boundary where the **event horizon** forms.

From the outside, it appears that nothing crosses that boundary. Light is stretched, the signal weakens, and time seems to stop. To an external observer, the star never finishes falling. But for the infalling matter, the process continues. In its own proper time, the contraction proceeds toward a center where the density grows without limit. It is there that the paradox arises.

1.3 The Paradox of the Body That Cannot Cross Itself

If the black hole already exists when the surface reaches the Schwarzschild radius, then its entire interior should also be trapped. However, every part of that interior—each layer, each atom—continues collapsing toward the center.

One can even imagine a **hypothetical fragment** of the black hole itself, a portion with a radius smaller than the total but with the same density. That fragment, having the same density and the same average gravitational field, **should also collapse by itself**. Thus, the interior of the black hole would be composed of parts that, in turn, are miniature black holes undergoing collapse toward their own singularities.

Here arises the fundamental contradiction: **it is impossible to go from the Schwarzschild radius to the singularity without passing through the singularity of the parts.**

Each fragment of the body moves toward its own individual collapse. If all the parts are destroyed separately, the whole ceases to exist as a body before reaching the supposed central singularity. The concept of a "star compressed into a point" loses all physical meaning: between the horizon and the singularity, there is no continuous object—only a set of trajectories that end without a whole to unify them.

1.4 Loss of Internal Relativistic Invariance

The disintegration of the body into independent parts eliminates the field continuity upon which general relativity is formulated. Without material continuity or a coherent metric, the principle of covariance ceases to be applicable. Therefore, the interior of a black hole not only lacks a physical description but **loses the very possibility of being relativistically invariant**. This rupture marks a structural limit of the theory and requires the presence of an underlying continuous medium—such as the scalar pressure field Ψ in QuarkBase Cosmology—to restore the coherence of the collapse.

1.5 The Discontinuity of the Theory

This is the true gap in classical physics. General relativity predicts the formation of the horizon and accurately describes its exterior, but it does not explain how a material structure can maintain its coherence beyond that boundary.

Inside the horizon, time and space exchange their roles: the radial coordinate behaves like time, and time ceases to be a stable direction. In that environment, speaking of "density," "volume," or "body" loses all meaning. The problem is not only mathematical but physical: **the description breaks down.**

We say that the collapse continues until a singularity, but the very notion of "continuing" loses significance. What was once a body ceases to exist as such before reaching it. The theory jumps from a real object to an abstract point of infinite curvature without describing the intermediate path.

And, surprisingly, this discontinuity is almost never mentioned. It is as if the scientific community had accepted living with a logical void in the midst of the most successful theory in history. Yet the gap is too large to ignore: it constitutes one of the **most severe paradoxes of contemporary theoretical physics**, an inconsistency between the physical existence of matter and the mathematical continuity of space-time.

1.6 Toward a Continuous Description

Resolving this paradox requires a framework that preserves the continuity of the physical medium. **QuarkBase Cosmology** proposes precisely that: a universe composed of a continuous, frictionless plasmatic ether in which gravity arises as a pressure gradient and black holes are regions where the ether ceases to vibrate.

In this approach, collapse does not destroy matter but transforms its mode of existence—from dynamic vibration to confined pressure. There is no singularity, only a region where the capacity to resonate disappears. Thus, the black hole ceases to represent a rupture of space-time and becomes instead a state transition of the quarkic medium.

2 Technical Formulation of the Paradox

2.1 Statement of the Paradox

- Fact A: the object becomes a **black hole** as soon as a **trapped surface** appears and the **horizon** forms at $r = R_s = \frac{2GM}{c^2}$.
- Fact B: inside the horizon, **every** material particle follows **timelike** geodesics that terminate at $r = 0$ in a **finite proper time** ($\tau \sim R_s/c$).
- Fact C: speaking of an "extended body" requires a **spatial hypersurface** that simultaneously contains "all its parts."
- Conflict: **no such hypersurface exists** that crosses the interior region as a "solid" between R_s and $r = 0$. The interior does not admit the classical notion of a continuous "body" that survives as a single entity. Result: an unavoidable "singularity of the parts," with no "body" capable of traversing it.

2.2 Where Classical Intuition Breaks Down

2.2.1 Interior Causal Reversal

Schwarzschild metric, Region II (interior):

- The coordinate (r) becomes **temporal**.
- Null and timelike geodesics satisfy $r(\tau) \downarrow 0$. There is no "material surface at rest"; "rest" would require $dr/d\tau = 0$, which violates the interior causal structure.

2.2.2 Impossibility of a "Rigid Body"

- **Born rigidity** is impossible in relativity under extreme accelerations and closed light cones.
- Proper distances between internal "parts" cannot be maintained; every "fragment" has its own causal destiny toward (r = 0).

2.2.3 Finite Proper Time for Each Part

For radial free fall from the horizon: [

$$\tau_{\text{hor}\to 0} \approx \frac{R_s}{c} = \frac{2GM}{c^3}$$

Each **part** reaches $r = 0$ in finite proper time. There is no "total body" that remains as a simultaneous entity between R_s and 0.

2.2.4 Oppenheimer–Snyder Does Not Preserve the "Body"

The dust–FRW collapse matches smoothly to the exterior, but it does **not** provide an interior "solid." Once the trapped surface forms, the "object" ceases to be a simultaneous 3-volume. What remains are **worldlines** that terminate.

2.3 Where the "Discontinuity" Lies

- It is **not** a mathematical discontinuity of the metric (the solution remains valid).
- It **is** an **ontological and operational** discontinuity: the category "extended body with density $\rho(\mathbf{x}, t)$" ceases to be definable as a macroscopic variable between R_s and 0.
- The **energy–momentum tensor** $T_{\mu\nu}$ may remain locally well defined up to near the singularity, but there is **no** global 3-hypersurface that describes "the entire object" in that phase. This destroys the notion of "preserving body continuity" beyond the horizon. One cannot reach the singularity without passing through the singularity of the parts.

2.4 Formal Translation

- Horizon: existence of trapped 2-spheres $\Rightarrow$ Penrose/Hawking theorems $\Rightarrow$ future **geodesic incompleteness** for interior timelike and null geodesics.
- "Body" density: requires $\rho(\mathbf{x}, t)$ defined over a **spatial slice** Σ_t. Inside the BH, any foliation that crosses the interior **does not** correspond to "a single physical time of the material" nor preserves the macroscopic spatial connectivity of the "solid."
- Technical conclusion: there exists no macroscopic **compact-body state** between R_s and 0—only local fields in free fall.

2.5 How to Resolve the Paradox in a Medium-Based Model (QuarkBase)

If the interior is replaced by a **continuous pressure medium** Ψ subject to a global constraint, one can **avoid** the destruction of the macroscopic category.

2.5.1 Ingredients

- Scalar pressure field Ψ with effective Lagrangian:
$$\mathcal{L} = \tfrac{1}{2}\,\partial_\mu\Psi\,\partial^\mu\Psi - \tfrac{1}{2}\,\mu^2\Psi^2 - J\Psi \quad \text{(conventional signs)}$$
- Effective tensor $T^{(\Psi)}_{\mu\nu}$ exhibiting **negative pressure** in the dense regime.
- **Global volume constraint** of the ether:
$$\int \rho_p\, d^3x + N\, v_q = \text{const}$$
- Screening length $\lambda = 1/\mu$ that defines the internal scale.

2.5.2 Collapse Stopping Condition

Radial balance in the comoving interior gauge:

$$\nabla_\mu T^{\mu r}_{(\text{matter})} + \nabla_\mu T^{\mu r}_{(\Psi)} = 0$$

If the ether pressure term produces

$$p_\Psi \approx -\kappa\, \Psi^2 \quad (\kappa > 0)$$

then an **effective force** $F_r = -\gamma v_q \nabla\Psi$ arises, capable of satisfying

$$|p_\Psi(r)| \sim \rho c^2 \quad \text{at } r = r_{\min} > 0$$

which **prevents** $r \to 0$ and defines a **minimum internal radius**. The collapse does not cross the "ontological discontinuity" because the macroscopic variable becomes definable again throughout the entire interior.

2.5.3 Global Coherence

The global conservation of volume requires a **compensatory expansion** outside the BH when the interior "sequesters" resonant volume. The "black hole" thus becomes a **region of high negative pressure** in the ether, without singularity.

2.6 Testable Predictions

- Ringdown with a **phase shift** relative to Kerr due to internal boundary conditions; possible weak **echoes**.
- Universal lower limit $r_{\min} = \alpha R_s$ with $\alpha \in (0, 1)$ depending on λ.
- Near-Kerr gravitational lensing but with a **slight shift** in the photon-sphere radius.
- Long-term evolution with a **slow leakage** of etheric energy $\to$ minimally decaying effective masses.

3 Conclusion

- In classical GR, a contradiction emerges—a real "impossibility": there is no "body" that crosses from the horizon to $r = 0$ as an entity. Only a "singularity of the parts."
- The paradox is not numerical but **conceptual**: the macroscopic category fails.
- An internal medium with effective pressure and a global constraint (the Ψ field) restores physical continuity and removes the singularity.

The paradox remains. General relativity explains the horizon and predicts the singularity, but it cannot describe what happens between them. That interval—where the body ceases to exist as a body—is a **logical gap** that the theory has accepted without resolving. Black

holes, in classical physics, are complete entities built upon a discontinuity: an object that continues its fall when there is no longer an object to fall. The formalism works, the equations close, yet **physical reality disintegrates within the theory itself.**

Everything indicates that the flaw does not lie in the mathematics but in the concept of matter itself. If space and energy are continuous, they cannot contain regions where continuity disappears. The singularity is not a prediction of the universe but rather a symptom of an incomplete description.

Several recent approaches have attempted to restore that lost continuity:

- **Gravastars** propose replacing the singularity with a bubble of vacuum energy exhibiting negative pressure.
- **Planck stars** from loop quantum gravity posit an internal bounce occurring when the maximum possible density is reached.
- **Emergent gravity** theories interpret space-time as a collective fluid with macroscopic properties analogous to those of a medium.
- **Boson star** models imagine collapse halted by a stable condensate of scalar fields.

All share the same intuition: nature does not destroy its own continuity. Yet none succeeds in formulating a single physical medium that sustains it from particles to black holes.

Along this line, **QuarkBase Cosmology** offers a coherent proposal: a universe composed of a continuous, frictionless plasmatic ether in which both particles and gravity are configurations of the same pressure field Ψ. Within this framework, stellar collapse does not produce a rupture of space-time but a region of the ether that ceases to vibrate. The black hole becomes a confined-pressure zone that preserves the universe's global volume and replaces the singularity with a well-defined physical state.

This approach, developed in detail in *"Formation of Black Holes According to QuarkBase Cosmology"*, suggests that the universe does not lose its coherence even in its most extreme regions. But that is another story. What remains here is the evidence of an unresolved paradox: **classical physics cannot take us from the Schwarzschild radius to the singularity without destroying the very concept of matter.**

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